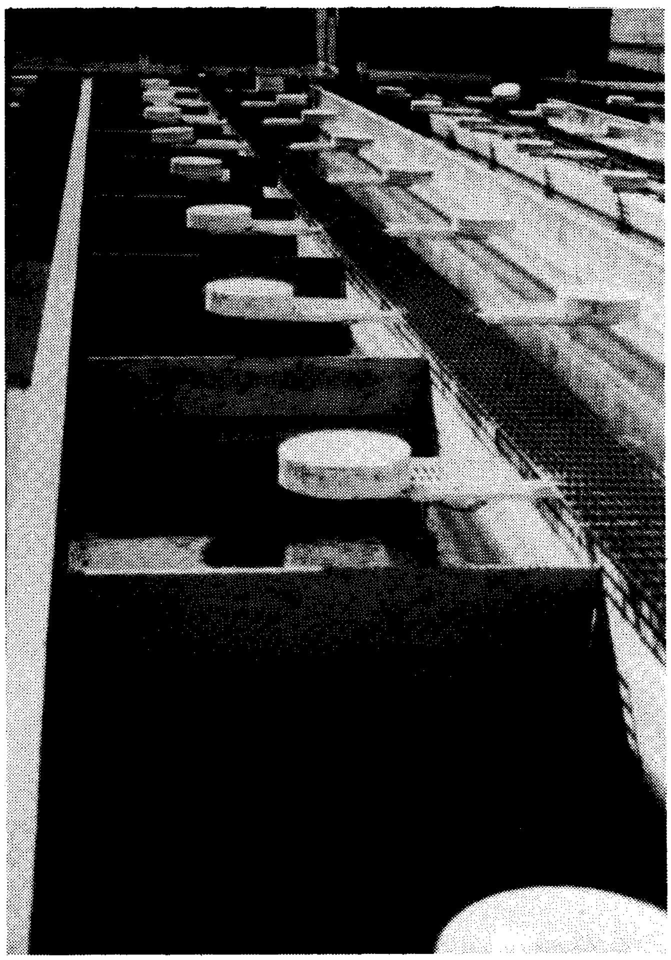
Hatchery 09
Article 11

HATCHERY RESEARCH

Idaho Power

RAPID RIVER HATCHERY RACEWAY BAFFLE EXPERIMENT

March 18, 1988 - April 30, 1988



By

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INTRODUCTION

In recent years, many hatcheries in the United States have been examining the use of baffles in raceways as a means of removing unwanted fecal material, silt, leaves, and other debris. The general idea is that by installing several strategically-placed "baffles" in a raceway, the water is diverted below the baffles and forces the debris through the system continually. This eliminates the need for sweeping the raceways and creating unnecessary stress on the fish. It has proven to be an effective way of removing fecal material at many hatcheries (Westers 1986) and provides a cleaner environment for the fish because the solids accumulate at the end of the raceway, where they are removed.

Because of the heavy silt-load at Rapid River Hatchery during the time the raceways are occupied, it was questioned whether baffles would be effective. If they were, it would save at least 405 man-hours (3 employees x 2.5 hours x 3 times per week x 18 weeks per year) of labor-intensive work sweeping raceways, as well as reduce stress on the fish. Savings would be much higher during a high-water year because of the increased amount of suspended material in the water over a longer period of time, thus requiring additional sweeping. Therefore, it was decided to set up an experiment to test the feasibility of baffles at Rapid River Hatchery.

OBJECTIVES

1. To determine if baffles will remove settleable solids from the raceways, thereby eliminating the need for sweeping.

2. To evaluate growth rates, conversion, mortality, and fish health of spring chinook salmon in a raceway containing baffles.

METHODS

Spring chinook salmon fry from the 1987 Rapid River brood year were used in the 44-day study. Approximately 475,000 fry averaging 1.68 inches were placed in each of two raceways (6 ft. x 90 ft. x 3 ft.). Water flows of 1 cfs were delivered to each raceway continuously, providing a turnover rate of 2.2 exchanges per hour. Baffles measuring 6 ft. x 3 ft. were constructed of 3/4-inch exterior plywood and were placed in one raceway at 10-foot intervals about 5 inches off the bottom using a slotted 2-inch diameter "leg" on the bottom of the board (Figure 1). These were placed in the raceway five weeks after the fry had been stocked. The top of the baffle was about six inches below

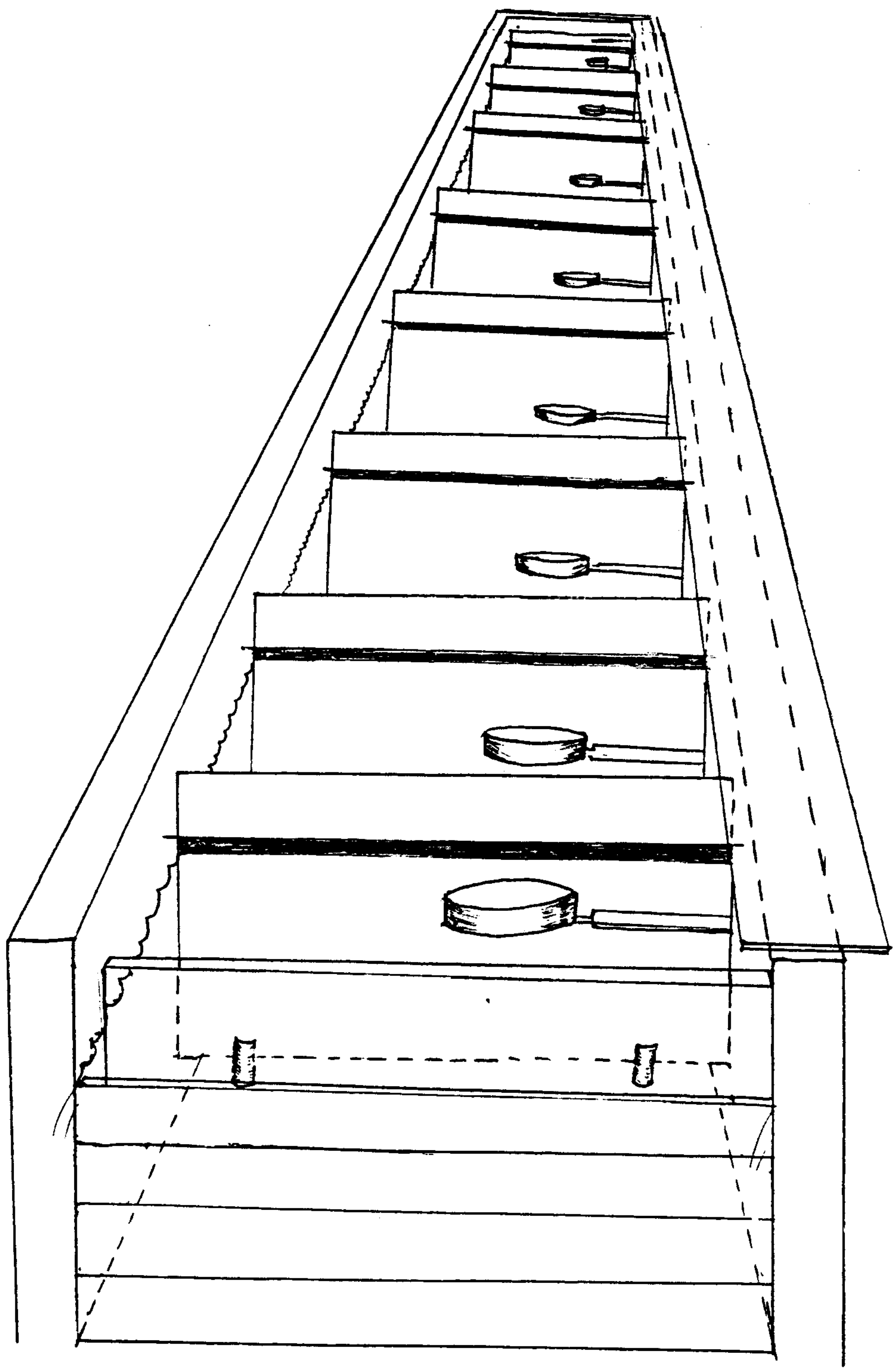


Figure 1. Raceway with baffles and Allen feeders.

the raceway wall, but above the water level in the raceway. Standard 3/8- inch machine bolts secured the upper part of the baffle against the concrete wall. The following formula was used to give an estimate of the distance off the bottom to place the baffles (Streeter 1971):

$$Q = V \times A$$

where Q = flow (m/s)
V = velocity (m/s)
A = area perpendicular to the flow (m)

Some adjustment was necessary to fine-tune the optimum distance off the bottom to give the greatest performance. This was dependent on the distance between each baffle and the flow through the raceway. Further information regarding beginning stocking rates, condition factor, feed used, and rearing indices is listed in Table 1.

Table 1. Beginning information for baffleboard experiment at Rapid River Hatchery, 1988.

Starting Information:	Raceway without bafflebоards	Raceway with baffleboards
Number	472,881	472,428
Fish/lb.	792	827
Length	1.69"	1.67"
Weight	597 lbs.	571 lbs.
Condition factor (C)a	2.6	2.6
Feed	Biodiet #3	Biodiet #3
Feedings/day	8	8
Density index	.33	.32
CFS	1.0	1.0
Flow index	.79	.76

[a](C) = Avg. wt. (lbs.) of one fish / (Avg. length (inches) of one fish) x 10,000
[b]2,200 fish died as a result of improper baffle placement--see Results and Discussion.

Feed was hand-delivered to the fish eight to ten times per day, generally on the hour. Both groups were also supplemented using Allen automatic feeders. Feed amounts were based on past hatchery records (Table 2) and calculated using the "hatchery constant" method as described by Piper et. al. 1982. Mortalities were collected and numbers recorded each time the raceway without baffles was cleaned (three times per week). The raceway with baffles needed some cleaning in the last five feet of the raceway at the same time to remove accumulated debris.

Sample counts were taken at the beginning of the experiment, on March 31, April 15, and at the end of the experiment. Lengths

Table 2. FEED AND GROWTH HISTORY INFORMATION BASED ON AVERAGED PREVIOUS YEARS DATA FOR SPRING CHINOOK SALMON AT RAPID RIVER HATCHERY

MONTH	AVG. WATER TEMP. (F)	DENSITY INDEX	FLOW INDEX	FEED CONV.	HATCHERY CONSTANT	AVG.DAILY LENG.INC.	MONTHLY LENG.INC.	CONDITION FACTOR	% BODY WT. FED	NO. FEEDINGS PER DAY	AVERAGE NO. PER LB. AT END OF MONTH	AVERAGE LENGTH AT END OF MONTH
FEB.	38	N/A	N/A	3	1.98	0.0022	.07	0.00026	1.42	8	1084	1.53
MARCH	41	0.25	.54*	1.3	2.85	0.0073	.22	0.00028	1.89	8	847	1.62
APRIL	44	0.28	0.5	1.5	5.27	0.0117	.35	.0003	3.00	8	461	1.93
MAY	46	0.28	.68*	2	4.80	0.008	.24 *	.0003	2.30	8	293	2.25
JUNE	48	0.07	0.76	1.19	7.50	0.021	.63	.0003	2.93	4	141	2.87
JULY	53	0.09	0.87	1.56	7.49	0.016	.48	.0003	2.36	5	79	3.48
AUG.	54	0.12	.77*	1.61	8.21	0.017	.51	.00035	2.23	5	49	3.88
SEPT.	50	0.14	1.35	1.67	6.36	0.0127	.38	.00035	1.56	4	36	4.30
OCT.	46	0.16	1.64	2.17	6.05	0.0093	.28	.00035	1.37	3	30	4.57
NOV.	41	0.17	1.87	3.71	1.89	0.0017	.05	.00035	0.41	2	29	4.62
DEC.	38	0.16	1.9	4.5	0.95	0.0007	.00	.00035	0.21	1	30	4.57
JAN.	37	N/A	1.95*	4.5	0.95	0.0007	.00	.00035	0.21	1	30	4.57
FEB.	38	N/A	2.1 *	2.5	2.48	0.0033	.10	0.00032	0.53	2	27	4.87
MARCH	41	N/A	N/A	1.8	4.48	0.0083	.25	0.00032	0.92	2	23	5.14

* Represents 1 year of data and is not a mean.

were taken at the start of the experiment, on March 31, and April 29, and conversions, condition factors (C), and mortality were calculated.

Fish health was monitored twice over the test period. A general necropsy of the fish, internal and external, was conducted, and fish were examined for BKD using standard gram-staining methods.

RESULTS AND DISCUSSION

The final numbers for the baffle experiment are presented in Table 3. This information is discussed in the text below.

Table 3. Final numbers for baffle experiment.

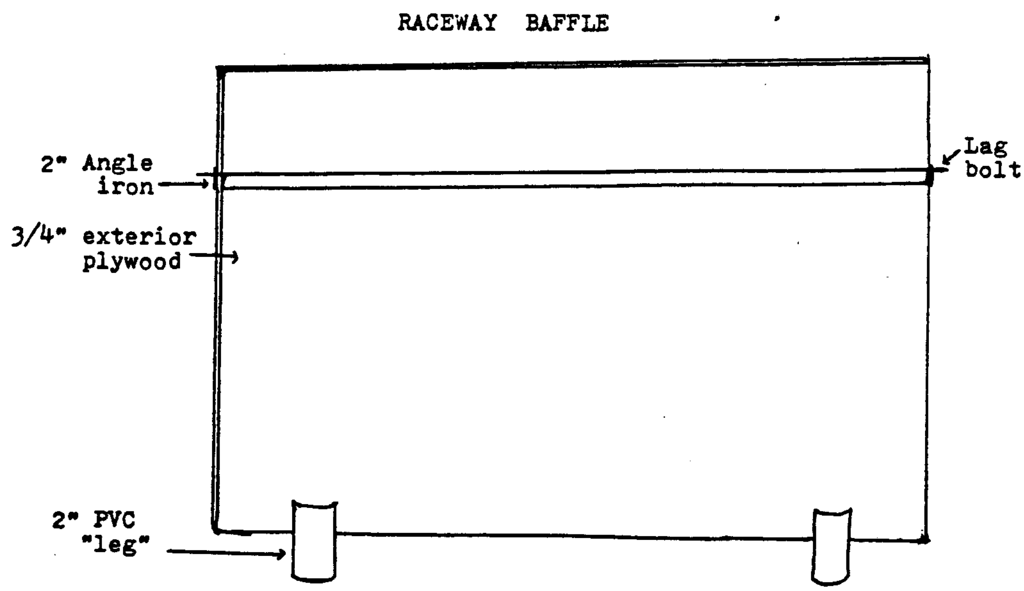
Ending Information:	Raceway without baffleboards	Raceway with baffleboards
Number	470,481	468,230
Fish/lb.	295	306
Length	2.2"	2.17"
Length increase	.51"	.5"
Weight	1,593 lbs	1,533 lbs.
Condition factor (C)[a]	3.18	3.2
Feed	Biodiet 1.0 & 1.3 mm	Biodiet 1.0 & 1.3 mm
Feedings/day	8	8
Density index	.45	.44
CFS	1.0	1.0
Flow index	1.61	1.57
Mortality	2,400	3,970[b]
Weight gain	996 lbs.	962 lbs.
Food fed	829 lbs.	800 lbs.
Conversion	.832	.832

[a] $(C) = \frac{\text{Avg. wt. (lbs.) of one fish}}{\text{(Avg. length (inches) of one fish)}} \times 10{,}000$

[b] 2,200 fish died as a result of improper baffle placement--see Results and Discussion.

Waste Removal

Baffles were very effective in removing unwanted fecal material, silt, and debris from the raceways. Once the baffles were properly installed, the waste settled to the bottom of the raceways and was flushed out below the baffles. Flow between the baffles followed •a circular pattern (Figure 2) and could be



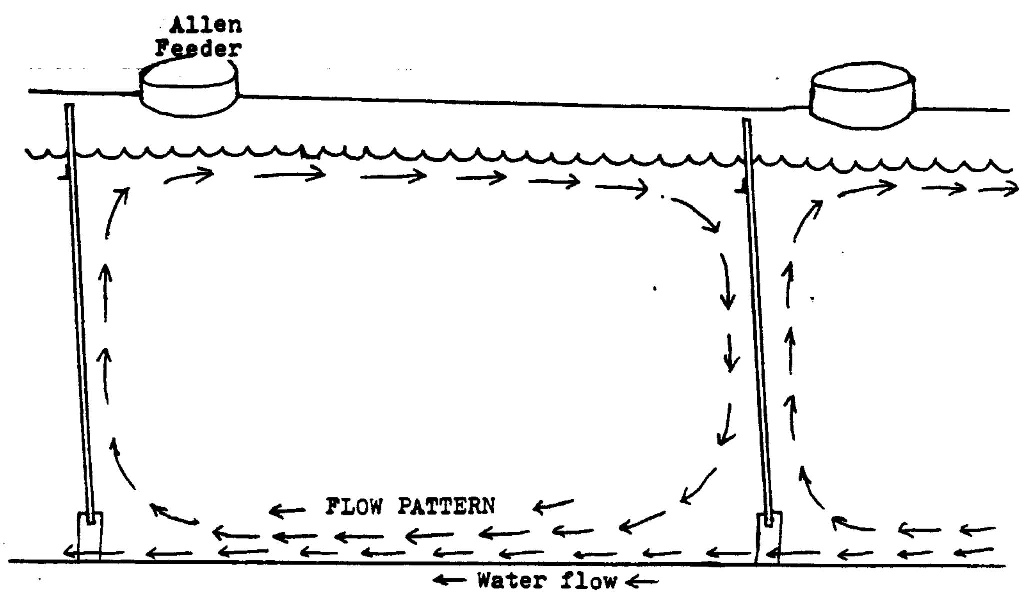


Figure 2. Side view of water flow pattern between baffles.

adjusted by tilting the baffles or varying the distance between the baffles until optimum performance was achieved. Fish moved freely between baffles and did not seem to be adversely affected by the current.

It is important to have sufficient flow beneath the baffles to remove the wastes, yet not so much as to prohibit movement of fish between the baffles. This is accomplished by visual observation of the turbulence between baffles, as well as fish movement. Too much turbulence indicates the baffles are too low and need to be raised, otherwise fish will put too much energy into swimming rather than growing and wastes will be resuspended, leading to reduced environmental quality. Too little turbulence will result in waste settling between the baffles and not being efficiently removed.

Because of the small amount of runoff this year, the silt entering the raceway was minimal; therefore, the silt-removing capabilties of the baffles could not be determined. However, all silt entering the raceway was removed.

Mortality

When the baffles were first placed in the raceway, a major concern was fish being impinged against the tailscreen. This concern was justified, as approximately 2,200 fish died as a result of a baffle placed too close (five feet) to the tailscreen during the initial installation. This baffle was removed, and the problem was eliminated.

Total mortality during the study period in the control group was 2,400 fish. Mortality in the experimental group was 3,970, including the 2,200 which died as a result of poor baffle placement. Mortality from March 18 to March 31 was 790 in the control group and 2,850 in the experimental group. Mortality over the final 30 days was 1,610 in the control group versus 1,120 in the experimental group. From this information, it is evident that once the baffles have been properly installed, there was no significant difference in mortality.

Fish Distribution

Surprisingly, fish in the raceway with baffles remained uniformly distributed throughout the raceway. Once the baffles were installed at their correct location, fish moved freely back and forth from each baffle section and did not appear to be adversely affected by the baffles.

Conversion

The conversion for both groups was .832 pounds of feed to produce one pound of gain, indicating that baffles during this study did not affect feed conversion rates.

Because the Allen feeders were permanently attached to the raceways, the placement of the baffles to get optimum benefit from both the feeders and baffles was limited. Therefore, the baffles were placed directly behind the feeders. When the feed dropped into the water, it moved with the current forward to the next baffle, then down and back to the baffle again (Figure 2). This rolling motion kept the feed in the water column much longer and traveled a greater distance, instead of sinking to the bottom immediately, thus increasing the chance that the particle would be eaten. However, conversions in both groups were identical.

Fish Health

Fish in both raceways were examined during the test period. Necropsies indicated no differences between the two raceways, and overall fish health appeared excellent throughout the experiment. Initial concern was expressed about the gills of the fish in the raceway with baffles because of the increased velocity of waste-filled water under the baffles. However, careful examination of the gills revealed no difference between the two groups; gills from both groups were in excellent condition.

Other

Growth among both groups was nearly identical. The control group grew .51 inches, while the experimental group grew .5 inches. Past hatchery records indicate the average condition factor (C) for this size fish and time of year at Rapid River ranges from 3.0 to 3.3. Condition factors were 3.18 for the control group and 3.2 for the experimental group--well within the normal range.

RECOMENDATIONS

Raceways fitted with baffles performed just as well as those without. Mortality, fish health, conversion, condition factor, and growth rate were almost identical, thus indicating that during this study, baffles had no adverse affects on these indices. The time and money saved at Rapid River Hatchery from the use of baffles is an estimated 405 hours labor (3 employees x 2.5 hrs x 3 times per week x 18 weeks = 405), or a minimum of

$1,887 dollars per year if only laborer classification employees were used ($4.66/hour).

From this information, it is recommended that baffles be installed in the raceways at Rapid River Hatchery. These should be made from a long-lasting material such as stainless steel, PVC, or aluminum, rather than exterior plywood. Plywood was used only to determine their effectiveness, but would need to be replaced frequently and would not be cost-effective over a long period of time.

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